

CLAIMS

1. A vinyl-urethane copolymer comprising at least one vinyl polymer chain and at least one urethane polymer chain,  
5 the vinyl polymer chain being combined with the urethane polymer chain through the intermediary of a linkage segment having a silicon-oxygen bond.

2. The vinyl-urethane copolymer of claim 1, wherein the  
10 urethane polymer chain is a residue of a urethane polymer (A) having at least one silicon-containing hydrolyzable group, and the vinyl polymer chain is a residue of a polymer derived from an ethylenically unsaturated monomer (B) and a compound (C) as monomer components, wherein the compound (C)  
15 comprises at least one functional group reactive with a silicon-containing hydrolyzable group and at least one functional group reactive with an ethylenically unsaturated bond-containing group.

20 3. The vinyl-urethane copolymer of one of claims 1 and 2, wherein the linkage segment is a silicone polymer chain.

4. The vinyl-urethane copolymer of claim 3, wherein the silicone polymer chain is derived from: a silicon-  
25 containing hydrolyzable group of a urethane polymer (A)

having at least one silicon-containing hydrolyzable group; a functional group reactive with a silicon-containing hydrolyzable group of a compound (C) having at least one functional group reactive with a silicon-containing hydrolyzable group and at least one functional group reactive with an ethylenically unsaturated bond-containing group; and a silane compound (D) comprising at least one silicon-containing hydrolyzable group.

10        5. The vinyl-urethane copolymer of any one of claims 2 to 4, wherein the urethane polymer (A) having at least one silicon-containing hydrolyzable group is an alkoxysilylated urethane polymer (A1) containing at least one hydrophilic group.

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6. The vinyl-urethane copolymer of claim 5, wherein the alkoxysilylated urethane polymer (A1) containing at least one hydrophilic group is a urethane polymer containing at least one hydrophilic group and having at least one terminal alkoxysilyl group, the urethane polymer corresponding to a hydrophilic group-containing urethane polymer, except with at least part of terminal isocyanate groups being alkoxysilylated.

25        7. The vinyl-urethane copolymer of one of claims 5 and 6,

wherein the alkoxysilylated urethane polymer (A1) containing at least one hydrophilic group is a urethane polymer containing at least one hydrophilic group and having at least one terminal alkoxysilyl group, as a reaction product  
5 among a compound (A1-a) containing plural isocyanate-reactive groups and having no hydrophilic group; a compound (A1-b) containing at least one hydrophilic group and plural isocyanate-reactive groups; a polyisocyanate compound (A1-c); and an alkoxysilane compound (A1-d) containing at least  
10 one isocyanate-reactive group.

8. The vinyl-urethane copolymer of any one of claims 4 to 7, wherein the silane compound (D) having a silicon-containing hydrolyzable group is an alkoxy group-containing  
15 silane compound.

9. The vinyl-urethane copolymer of any one of claims 2 to 8, wherein the ethylenically unsaturated monomer (B) comprises an acrylic monomer.  
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10. The vinyl-urethane copolymer of any one of claims 2 to 9, wherein the compound (C) having at least one functional group reactive with a silicon-containing hydrolyzable group and at least one functional group  
25 reactive with an ethylenically unsaturated bond-containing

group is a compound comprising a silicon-containing hydrolyzable group and an ethylenically unsaturated bond-containing group, or a compound comprising a silicon-containing hydrolyzable group and a mercapto group.

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11. A method for producing a vinyl-urethane copolymer comprising at least one vinyl polymer chain and at least one urethane polymer chain, the vinyl polymer chain being combined with the urethane polymer chain through the intermediary of a linkage segment having a silicon-oxygen bond, the method comprising following Steps (X) and (Y):

Step (X) of carrying out preparation of an aqueous dispersion or aqueous solution of a urethane polymer (A) having at least one silicon-containing hydrolyzable group; and

Step (Y) of, in the aqueous dispersion or aqueous solution of the urethane polymer (A) having at least one silicon-containing hydrolyzable group, carrying out polymerization of an ethylenically unsaturated monomer (B), and carrying out preparation of a vinyl-urethane copolymer using a compound (C) in at least one period selected from the group consisting of before the polymerization reaction, during the polymerization reaction, and after the polymerization reaction, the compound (C) having at least one functional group reactive with a silicon-containing

hydrolyzable group and at least one functional group reactive with an ethylenically unsaturated bond-containing group.

- 5      12. The method for producing a vinyl-urethane copolymer of claim 11, wherein Step (Y) is at least one step selected from the group consisting of following Steps (Y1-a), (Y1-b), (Y1-c), and (Y1-d):

10      Step (Y1-a) of, in the aqueous dispersion or aqueous solution of the urethane polymer (A) having at least one silicon-containing hydrolyzable group, carrying out the polymerization of the ethylenically unsaturated monomer (B) simultaneously with a reaction using the compound (C) having at least one functional group reactive with a silicon-  
15      containing hydrolyzable group and at least one functional group reactive with an ethylenically unsaturated bond-containing group, to thereby yield a vinyl-urethane copolymer;

20      Step (Y1-b) of, in the aqueous dispersion or aqueous solution of the urethane polymer (A) having at least one silicon-containing hydrolyzable group, carrying out the polymerization of the ethylenically unsaturated monomer (B) and subsequently carrying out a reaction using the compound (C) having at least one functional group reactive with a  
25      silicon-containing hydrolyzable group and at least one

functional group reactive with an ethylenically unsaturated bond-containing group, to thereby yield a vinyl-urethane copolymer;

Step (Y1-c) of, in the aqueous dispersion or aqueous  
5 solution of the urethane polymer (A) having at least one silicon-containing hydrolyzable group, carrying out a reaction using the functional group reactive with a silicon-containing hydrolyzable group of the compound (C) having at least one functional group reactive with a silicon-  
10 containing hydrolyzable group and at least one functional group reactive with an ethylenically unsaturated bond-containing group, and subsequently carrying out the polymerization of the ethylenically unsaturated monomer (B) simultaneously with a reaction using the functional group  
15 reactive with an ethylenically unsaturated bond-containing group of the compound (C) having at least one functional group reactive with a silicon-containing hydrolyzable group and at least one functional group reactive with an ethylenically unsaturated bond-containing group, to thereby  
20 yield a vinyl-urethane copolymer; and

Step (Y1-d) of, in the aqueous dispersion or aqueous solution of the urethane polymer (A) having at least one silicon-containing hydrolyzable group, carrying out a reaction using the functional group reactive with a silicon-  
25 containing hydrolyzable group of the compound (C) having at

least one functional group reactive with a silicon-containing hydrolyzable group and at least one functional group reactive with an ethylenically unsaturated bond-containing group, subsequently carrying out the  
5 polymerization of the ethylenically unsaturated monomer (B) and a reaction using the functional group reactive with an ethylenically unsaturated bond-containing group of the compound (C) having at least one functional group reactive with a silicon-containing hydrolyzable group and at least  
10 one functional group reactive with an ethylenically unsaturated bond-containing group simultaneously with a reaction using another additional portion of the compound (C) having at least one functional group reactive with a silicon-containing hydrolyzable group and at least one  
15 functional group reactive with an ethylenically unsaturated bond-containing group, to thereby yield a vinyl-urethane copolymer.

13. The method for producing a vinyl-urethane copolymer  
20 of claim 11, wherein Step (Y) is at least one step selected from the group consisting of following Steps (Y2-a), (Y2-b) and (Y2-c):

Step (Y2-a) of, in the aqueous dispersion or aqueous solution of the urethane polymer (A) having at least one  
25 silicon-containing hydrolyzable group, carrying out

hydrolysis or condensation of a silane compound (D) having a silicon-containing hydrolyzable group, subsequently carrying out the polymerization of the ethylenically unsaturated monomer (B) and carrying out preparation of a vinyl-urethane copolymer using the compound (C) having at least one functional group reactive with a silicon-containing hydrolyzable group and at least one functional group reactive with an ethylenically unsaturated bond-containing group in at least one period selected from the group consisting of before the hydrolysis or condensation reaction, during the hydrolysis or condensation reaction, after the hydrolysis or condensation reaction and before the polymerization reaction, during the polymerization reaction, and after the polymerization reaction;

Step (Y2-b) of, in the aqueous dispersion or aqueous solution of the urethane polymer (A) having at least one silicon-containing hydrolyzable group, carrying out the polymerization of the ethylenically unsaturated monomer (B) simultaneously with hydrolysis or condensation of a silane compound (D) having a silicon-containing hydrolyzable group, and carrying out preparation of a vinyl-urethane copolymer using the compound (C) having at least one functional group reactive with a silicon-containing hydrolyzable group and at least one functional group reactive with an ethylenically unsaturated bond-containing group in at least one period



selected from the group consisting of before the hydrolysis or condensation reaction and the polymerization reaction, during the hydrolysis or condensation reaction and the polymerization reaction, and after the hydrolysis or

5 condensation reaction and the polymerization reaction; and

Step (Y2-c) of, in the aqueous dispersion or aqueous solution of the urethane polymer (A) having at least one silicon-containing hydrolyzable group, carrying out the polymerization of the ethylenically unsaturated monomer (B),  
10 subsequently carrying out hydrolysis or condensation of a silane compound (D) having a silicon-containing hydrolyzable group, and carrying out preparation of a vinyl-urethane copolymer using the compound (C) having at least one functional group reactive with a silicon-containing  
15 hydrolyzable group and at least one functional group reactive with an ethylenically unsaturated bond-containing group in at least one period selected from the group consisting of before the polymerization reaction, after the polymerization reaction and before the hydrolysis or  
20 condensation reaction, during the hydrolysis or condensation reaction, and after the hydrolysis or condensation reaction.

14. The method for producing a vinyl-urethane copolymer of claim 13, wherein the silane compound (D) having a  
25 silicon-containing hydrolyzable group comprises a silane

compound having at least one functional group reactive with an ethylenically unsaturated bond-containing group in combination with a silane compound free from a functional group reactive with an ethylenically unsaturated bond-  
5 containing group.

15. The method for producing a vinyl-urethane copolymer of any one of claims 11 to 14, wherein Step (X) is following Step (X1):

10 Step (X1) of carrying out preparation of a urethane polymer (A) having at least one silicon-containing hydrolyzable group using an ethylenically unsaturated monomer (B) as a solvent to yield a reaction mixture, and dispersing or dissolving the reaction mixture in water to  
15 thereby yield an aqueous dispersion or aqueous solution of the urethane polymer (A) having at least one silicon-containing hydrolyzable group.

16. The method for producing a vinyl-urethane copolymer  
20 of any one of claims 11 to 15, wherein the urethane polymer (A) having at least one silicon-containing hydrolyzable group used in Step (X) is an alkoxysilylated urethane polymer (A1) containing at least one hydrophilic group.